

Fresh Water Pollution: Chemical and Physical Parameters

Background

New Jersey contains a wide variety of water resources. Within the state's 7,788 square miles are 127 miles of coastline; 7,840 miles of rivers and streams and 69,920 acres of lakes and ponds larger than 2 acres. In addition, there are 1,482 square miles of fresh and saline marshes and wetlands, and 1,069 square miles of coastal waters.¹

New Jersey has adopted Surface Water Quality Standards (SWQS) to protect these water resources. The SWQS establish the designated uses and specify the water-quality criteria necessary to protect the state's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation.

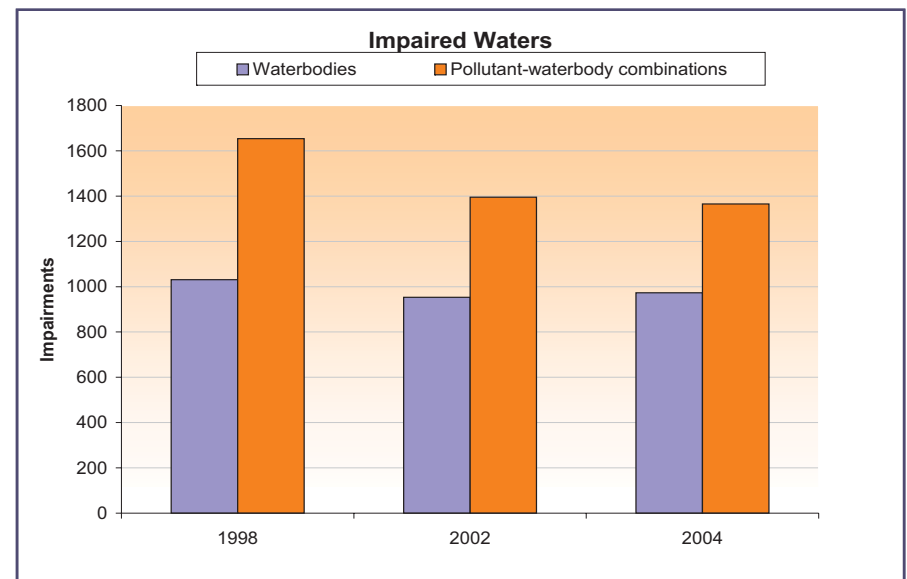
The federal Clean Water Act requires states to develop a list of impaired waters, such as water bodies with confirmed violations of surface water quality standards, water bodies suspected of designated use impairments and water bodies that did not fully support or were projected to not support their designated uses. The DEP used a combination of anecdotal information and monitoring data to develop its 1998 list. This list identified the name of the water body and the pollutant or pollutants causing the water body to be listed as impaired. To ensure that New Jersey meets its obligation to restore water quality to impaired water bodies, EPA and New Jersey entered into a Memorandum of Agreement in May 1999. This document established a deadline of March 31, 2011 to address all impairments listed on the 1998 list. For each impairment on the list, DEP is required to develop a Total Maximum Daily Load (TMDL), a calculation of the maximum amount of a pollutant a water body can receive and still meet water-quality standards.

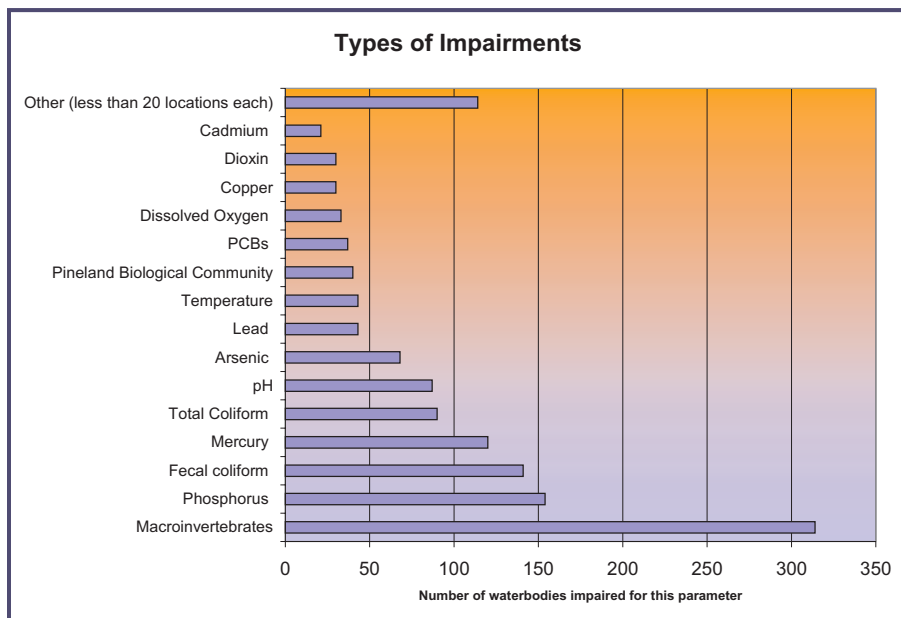
DEP, along with U.S. Geological Service (USGS), EPA, local governments and environmental groups, monitor the quality of the state's waters. The DEP/USGS Cooperative Ambient Surface Water Monitoring Network consists of 115 stations that are sampled for metals, pesticides/volatile organic chemicals, sediments and other contaminants. The biological health of New Jersey's streams is assessed by DEP at more than 800 locations by sampling and studying insects, worms, clams and other indicator species. Additionally, a visual assessment is made of the in-stream substrate, channel morphology,

bank structural features, and riparian vegetation 100 to 200 feet around each biological sampling site. Fish surveys also are conducted to evaluate biological conditions and ensure use classifications remain updated.

Status and Trend

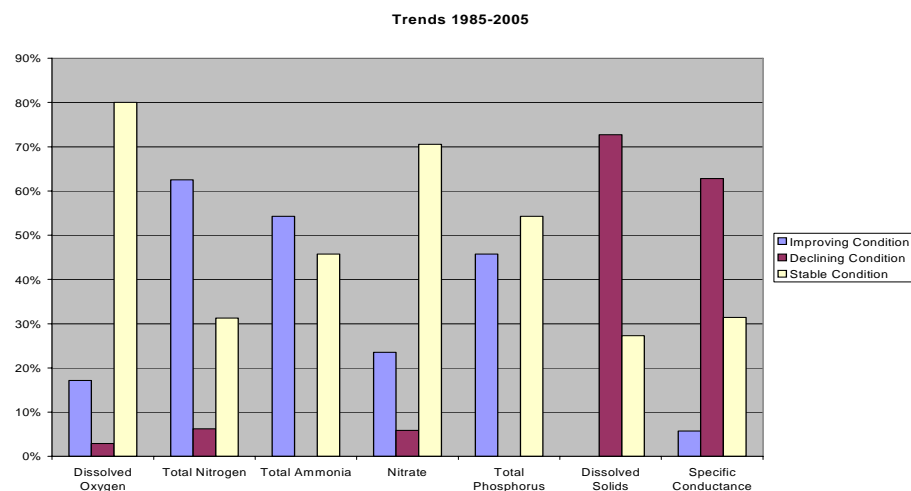
A water body remains on the impaired list until water-quality standards are met or the impairments have been addressed through a TMDL. The DEP expects the number of water bodies and the pollutant-water body combinations² will remain fairly flat over the next few years or actually increase, as data becomes available to assess more waters (See Impaired Waters Figure). The DEP has limited resources to monitor the quality of the state's water bodies and continues to seek water-quality data from other sources to supplement this effort.



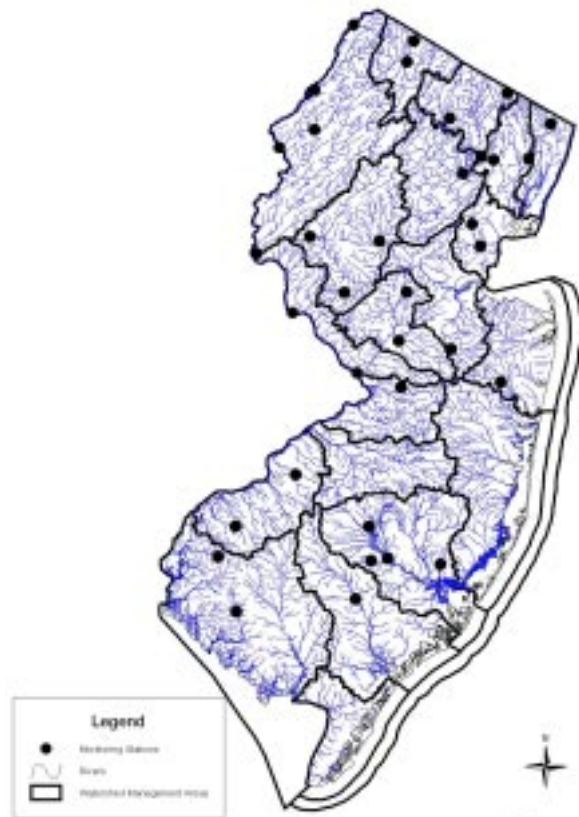


The Types of Impairments Figure shows the various parameters for which water bodies are impaired. The largest impairment by far is for macroinvertebrates. If a water body is considered impaired because of macroinvertebrates, it means that the population of certain insect larvae, worms, crustaceans and other organisms, collectively called macroinvertebrates, in that water body is deficient in some way from what would be likely to be found in a similar, but unpolluted water body. (For more information regarding this impairment see Surface Water Pollution; Streams; Ambient Biomonitoring Network and Fish Index of Biotic Integrity Network chapter of this report).

Recently, a trend analysis³ of some important water quality characteristics was conducted for the time period between 1985 to 2004 at 36 monitoring sites, located throughout the state. (See map of sites). These sites were selected because they were identified as monitoring sites with available long-term data for the study's 20 year time period. All of the sites are in the USGS/ NJDEP Ambient Surface Water Monitoring Network and were sampled at least quarterly. The following water quality characteristics were assessed in the trends analysis: dissolved oxygen, nutrients (total nitrogen, total ammonia, nitrate, and total phosphorus), dissolved solids, and specific conductance.



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Preliminary results indicate that nutrients show improving or stable conditions throughout the state. The nitrogen species of most interest are nitrate and ammonia because they are the most readily available form of nitrogen taken by organisms and plants as a nutrient (see also note). Phosphorus is also readily used by organisms and plants as a nutrient. Together, these nutrients are principally responsible for the growth rate of aquatic algae and vegetation. Water bodies affected by excessive primary production are characterized by significant algae and weed growth and episodes of low

dissolved oxygen. Low dissolved oxygen episodes occur when algae die off, and bacteria consume the dissolved oxygen in the process of decomposition.

Preliminary results also indicate that dissolved oxygen shows improving or stable conditions. Dissolved oxygen is necessary for almost all aquatic life; consequently concentrations of dissolved oxygen in water provide an indicator of the health of aquatic ecosystems. In low DO conditions, fish are more susceptible to other pollutants, such as metals and toxics, and in very low DO levels trace metals from the sediments are released into the water column.

These results are consistent with the expected improvements to water quality primarily from upgrades to wastewater treatment plants since the 1980's. Nutrient loads, especially ammonia, have been reduced through more extensive wastewater treatment.

The trend analysis also indicates declining conditions for total dissolved solids (TDS) and an associated measure, specific conductance (SC)⁴. TDS is comprised of minerals and other substances dissolved in water. Changes in TDS can affect organisms by altering the flow of water through cell membranes, which can retard growth or even cause death. These changes can make water less fit for other uses. TDS exceedances have been associated with runoff from urban and agricultural areas, including runoff of salt used to control ice on roadways. Wastewater treatment discharges and discharges from septic systems can also contribute to increased TDS loadings. The TDS and SC trends were found in all types of land uses (urban, agricultural, undeveloped, and mixed) and physiographic regions.

Outlook and Implications

DEP continues to focus on establishing TMDLs for existing impairments. Since 1996, EPA has approved 302 TMDLs for pollutant-water body combinations for New Jersey. The DEP has prioritized the development of TMDLs for fecal coliform, as this is one of the most frequent problems in the state. DEP also acknowledges that other types of actions, including changes to the SWQS, may be necessary to address pollutant-water body combinations currently listed as impaired.

As part of the biennial review process, DEP removes pollutant-water body combinations that have established TMDLs from the impaired waters list, removes pollutant-water body combinations that meet water-quality standards

based on new data, and adds new pollutant-water body combinations where new water-quality data shows violations. As of 2004, a total of 1,365 pollutant-water body combinations were identified as requiring a TMDL or other regulatory action.

There are various stages through which a TMDL goes before final adoption into the appropriate Water Quality Management Plan; they are the following:

- **Proposal:** This occurs when the TMDL amendment proposal appears in the NJ Register.
- **Establishment:** This occurs on the date that the Department formally submits it to EPA. The established TMDL document includes a response to comments made on the proposed TMDL.
- **Approval:** This occurs when EPA formally approves the TMDL
- **Adoption:** This occurs when the adoption notice appears in the NJ Register.

TMDL	Proposed	Established	Approved	Adopted
27 Streams in the Lower Delaware Region: Fecal Coliform	4/21/03	6/27/03	9/29/03	
28 Streams in the Northwest Region: Fecal Coliform	4/21/03	6/27/03	9/29/03	
3 Streams in the Atlantic Coastal Region: Fecal Coliform	4/19/04	8/25/04	9/29/04	
31 Streams in the Atlantic Coastal Region: Fecal Coliform	4/21/03	6/27/03	9/29/03	
48 Streams in the Raritan Region: Fecal Coliform	4/21/03	6/27/03	9/29/03	
9 Eutrophic Lakes in the Atlantic Coastal Region: Phosphorus	4/21/03	6/27/03	9/30/03	
13 Eutrophic Lakes in the Lower Delaware Region: Phosphorus	4/21/03	6/27/03	9/30/03	
3 Eutrophic Lakes in the Northeast Region: Phosphorus	1/21/03	3/28/03	9/17/03	
4 Eutrophic Lakes in the Northwest Region: Phosphorus	1/21/03	3/28/03	9/17/03	
Greenwood Lake: Phosphorus	6/7/04	9/10/04	9/29/04	
6 Eutrophic Lakes in Raritan Region: Phosphorus	1/21/03	3/28/03	9/30/03	
Cooper River Watershed: 4 Streams and 2 Lakes: Total Phosphorus	4/19/04	8/25/04	9/30/04	
Wallkill River and Papakating Creek: Arsenic	7/19/04	9/23/04	9/29/04	
Clove Acres Lake and Papakating Creek: Phosphorus	4/19/04	8/25/04	9/30/04	
Pequannock River: Temperature	6/7/04	9/23/04		
32 Streams in the Northeast Region: Fecal Coliform	1/21/03	3/28/03	7/29/03	

References

Much of the surface water quality information in this report was provided by DEP's Water Monitoring and Standards staff and the 2004 Integrated Water Monitoring and Assessment report. The information regarding TMDLs was provided by the Division of Watershed Management's TMDL Webpage and staff.

¹ Based on GIS 1:100,000 scale

² A pollutant-water body combination is an instance of a particular pollutant associated with a particular water body. For example, if a certain water body exceeds a water quality standard for two pollutants, it represents two pollutant-water body combinations. If a third pollutant is found also to be above the standard in that water body, there would be three pollutant-water body combinations.

³ Analysis incorporated USGS software, ESTREND, using the Seasonal Kendall and Tobit tests with a p-value = 0.05. Data flow-adjusted when applicable. Minimum number of samples per station was 40. Detailed description of ESTREND can be found in Shertz, T., Richard Alexander, and Dane Ohe, 1991, The Computer Program Estimate Trend (ESTREND), A System for the Detection of Trends in Water-Quality Data. US Geological Survey Water-Resources Investigations Report 91-4040. Reston, Virginia.

⁴ SC is a measure of how well water can conduct an electrical current. Water conducts electricity due to the presence of ions, which are negatively and positively charged entities in the water matrix. Concentrations of ions increase with increased concentrations of dissolved minerals and other substances. Therefore, SC is an indirect measure of the TDS.

More Information

www.state.nj.us/dep/wmm/sgwqt/
www.state.nj.us/dep/wmm/publications.html
www.state.nj.us/dep/watershedmgt/tmdl.htm
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